GLOBELICS

Market structure, technological innovation and industrial competitive advantage: Policy choices for catching up

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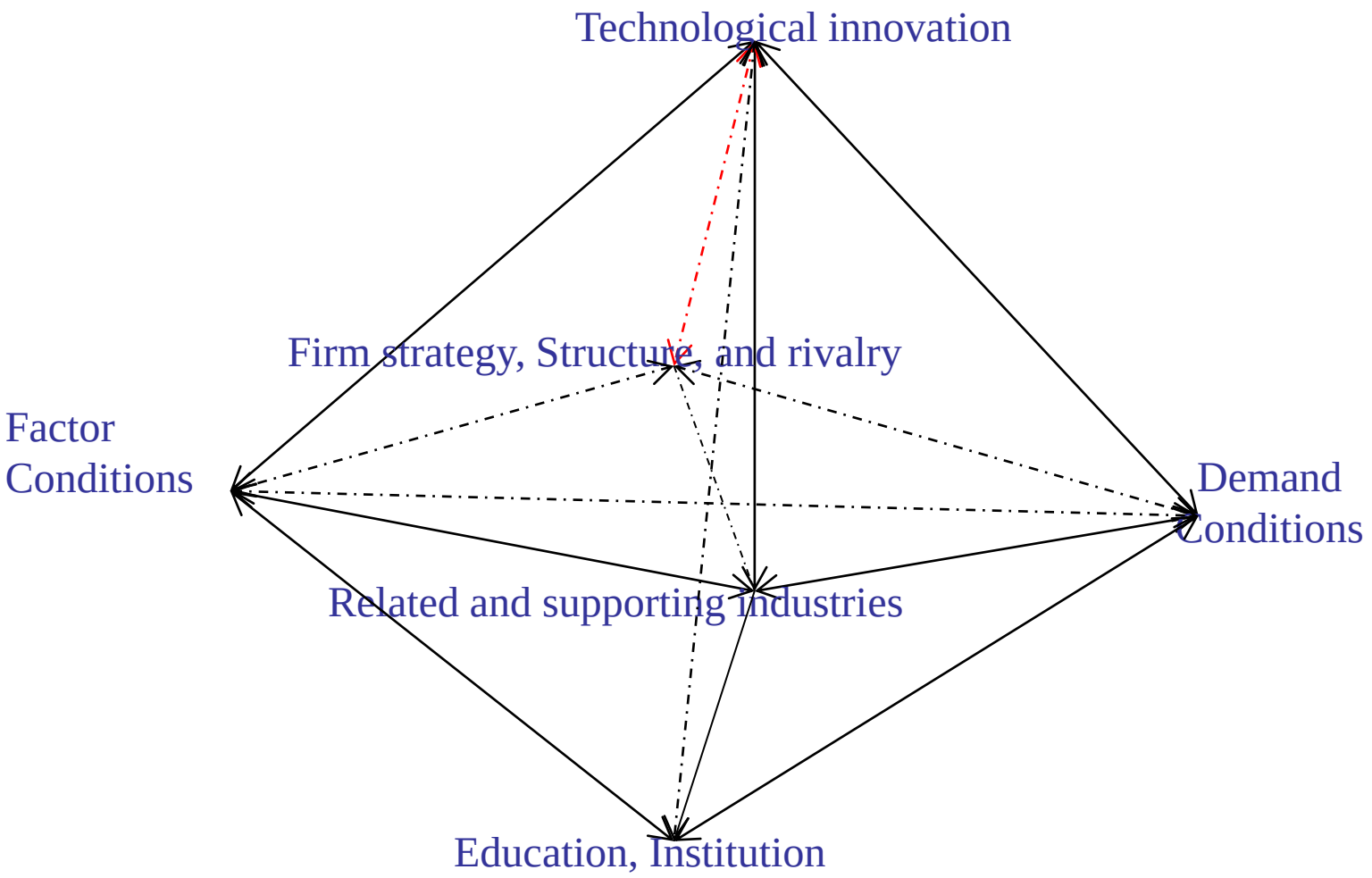


Figure: New Diamond

1. Research Questions

- What is the interaction?
- Could the developing countries improve their industry's competitiveness by managing the interactions?
- If they can, which path should the developing countries adopt?
- What policy should the governments of developing countries choose when there are conflictions between market structure and technological innovation?

2.Previous literatures:

Market structure and technological innovation

Cohen and Levin (1989)

the most notable feature of the empirical research on the relationship between firm size and innovation is its inconclusiveness,

but the majority of studies that examine the relationship between market concentration and R&D have found a positive relationship and few have found evidence that concentration has a negative effect on R&D.

market structure and technological innovation

- Theoretical support :
  the simulation models of Nelson and Winter (1978, 1982b).

The simulation models of Nelson and Winter (1982) devised a formal structure to demonstrate the connections that link market structure and technical progress in the game of dynamic competition.

3. Two alternative paths for later-comer to acquire competitive advantage

two paths:

- Setting up of large innovative enterprises under strong government support . (Korea, Japan)

- spontaneous atomistic firms which are supported by relative institutions with high innovative capacity. (Taiwan)

Technological innovation plays an important role in both paths. It might be not feasible if independent innovation is neglected and the later comers rely on foreign technology.

large innovative enterprises under strong government support --- Korea

- In the 1970s, The Korean government intentionally created large firms (Kim, 1993).

- The deliberate promotion of big business as an engine of technological learning, achieved through a systematic and comprehensive array of subsidies and incentives (Kim, 1997).

- Most importantly, the Cheabols took an independent and reverse engineering technological strategic route in early years of catching up and the Korean government restricted FDI but promoted instead technology transfer through other means (Kim, 1993).

Atomistic firms which are supported by relative institutions with high innovative capacity---Taiwan

- The superlative network of technology support institutions gives the Taiwanese small enterprises the backup they need to keep pace with technological change（Kim, Nelson, 2000).

- Government-sponsored research institutions are critical to technology development and diffusion in Taiwan (How, Gee, 1993). Taiwan SMEs rely heavily on the efforts of the government to develop technology or on government sponsored research institutions to transfer technology to them.

But this path gives it more flexibility but less depth in technology generation. As the industrial sector approaches technological frontiers, this may prove a disadvantage (Kim, Nelson, 2000).

4. Two Chinese cases of neglecting the important role of technological innovation on market structure and competitive advantages

- Chinese Automobile Industry
- Chinese Cosmetics industry

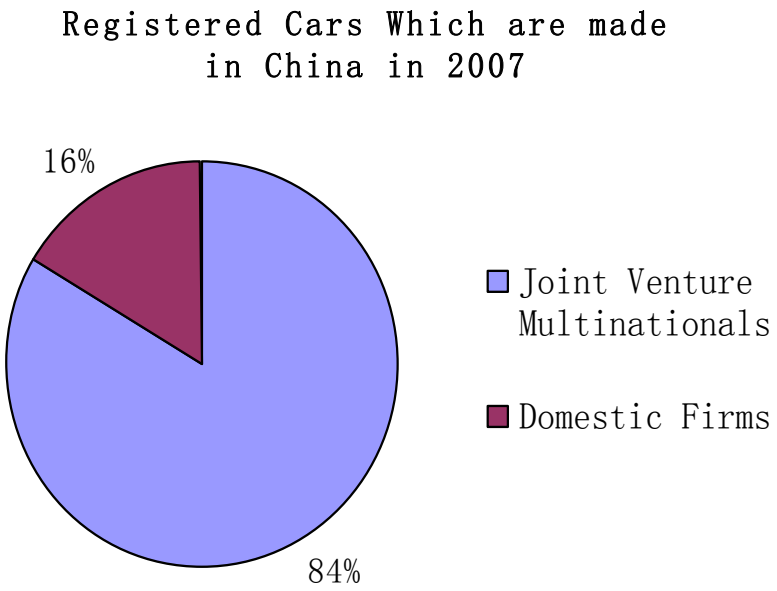
Chinese automobile industry

✓ 1953

✓ After 1986, the Chinese government Policy:

encouraging joint development with foreign companies according the policy of "High starting point, high-volume, specialization"

(national 5-year plans of economic development of 1986 and 1991)



	Annual Production of Cars (Units)
1986	9,000
2006	3,860,000

Chinese automobile industry

The big joint venture firms became the vassals of multinationals .

- Those policies had a fatal flaw that the government did not require the Chinese enterprises to improve their own learning and researching capabilities and the Chinese firms even lost their old R&D platform during the process of the inflowing of foreign capital（Lu, 2004）

- Those policies aimed only at high industrial concentration and never emphasized the importance of indigenous technological innovation capacity, which resulted in the reliance on the foreign technology and the lack of industrial competitiveness in the Chinese automobile industry.

Chinese automobile industry

- ✓ After 2001, some independent domestic firms are emerging such as Chery, Geely, Brilliance, Hafei etc. But the established joint venture multinationals had occupied the market.

Questions:

- Could the domestic firms grow up and have the capabilities to compete with the multinationals?
- What should government do to promote the development of those infant domestic firms?

Chinese Cosmetic industry

Since the opening up and the reform of China in the 1978, the history of the development of Chinese cosmetic industry is a history that a large number of small enterprises kept on trying to challenge the multinational but mostly failed.

Chinese Cosmetics industry

- Before 1982, there were 1300 cosmetic enterprises and the market concentration rate was low.

- The United States Procter & Gamble, Unilever United Kingdom, Germany-Higher entered the Chinese market in succession after 1982 and a large amount of Chinese domestic cosmetic firms have gone bankrupt or tried to seek mergers and joint ventures with foreign enterprises.

- After 1996, some Chinese domestic cosmetic firms found their niche market, such as Aoni, Manting, Sunrana, Softto, and Troy etc.

- But most of the domestic enterprises were just a flash in the pan and after 2002, the Chinese domestic cosmetic firms slumped and the multinationals hold the most cosmetic market again.

Chinese Cosmetics industry

Questions:

- what should the government do to promote the growing up of small domestic firms?
- To what extent should the government support the institutions to ensure domestic firms to grow up under the condition of multinationals dominating the market?

5. The model

- We will refer to the History-friendly model (Marlerba, Nelson, Orsennigo, Winter, 1999, 2002, 2207).

Suppose:

- there are only two kinds of firms in the market including multinationals and domestic firms.

- Both multinationals and domestic firms had their specific preferences to improve cheapness and performance and the preferences are determined for each firm at the start by a draw on the uniform distribution.

(For each firm, the preference to improve cheapness is θ_1 and the preference to improve performance is $\theta_2 = 1-\theta_1$.)

- When the multinationals entered the market, they had obviously advantage on technology especially on product performance.

The model

Suppose:

- Multinationals can acquire technology without cost from parent companies . The probability of acquiring technology of each firm in each period subjects to the normal distribution（N（$\lambda(t), \sigma^2$）.

- Domestic firms acquire technology by its own Research and development expenditures.

$$\Delta X_i = a_0 (R_i)^{a1} (X_{max} - X_i)^{a2} , \qquad i=1,2$$

(X_1， X_2 denote the attributes of Cheapness and performance respectively, For each period, R is the R&D expenditure and $R=\phi^*\pi_t$, where R is determined as a constant fraction, ϕ of gross profit π_t.)

The model

- For each domestic firm, $R_i = \theta_i R$. Price is obtained by adding a mark-up of cost: $p=k(1+\mu_t)$,

(here $\mu_t=0.1+0.1*m_i$. k is the production cost andμ_t is the mark up which is initially set equal for all the firms but it then grows over time a function of the market share that has been achieved, m_i is market share).

The model

- Form period to period, the quality of the design that a company is able to achieve in performance or cheapness improves according to the following equation

$$M=b_0(X_1-X_{1Min})^{b1}(X_2-X_{2Min})^{b2}$$

- The probability that any customer will consider a particular product for purchase in a particular period is:

$$P_i=C_0\ (M_i)^{C1}(m_i+d_1)^{\ C2}$$

6. The simulation runs

6.1 Government does not intervene in firms

- suppose there are 6 multinationals and 100 domestic firms in a market. The multinationals have technology advantage on performance but their products are more expensive than the products of domestic firms.

- suppose that multinationals can get technology from their parent companies and domestic firms can only get technology by its own R&D.

Government does not intervene in firms

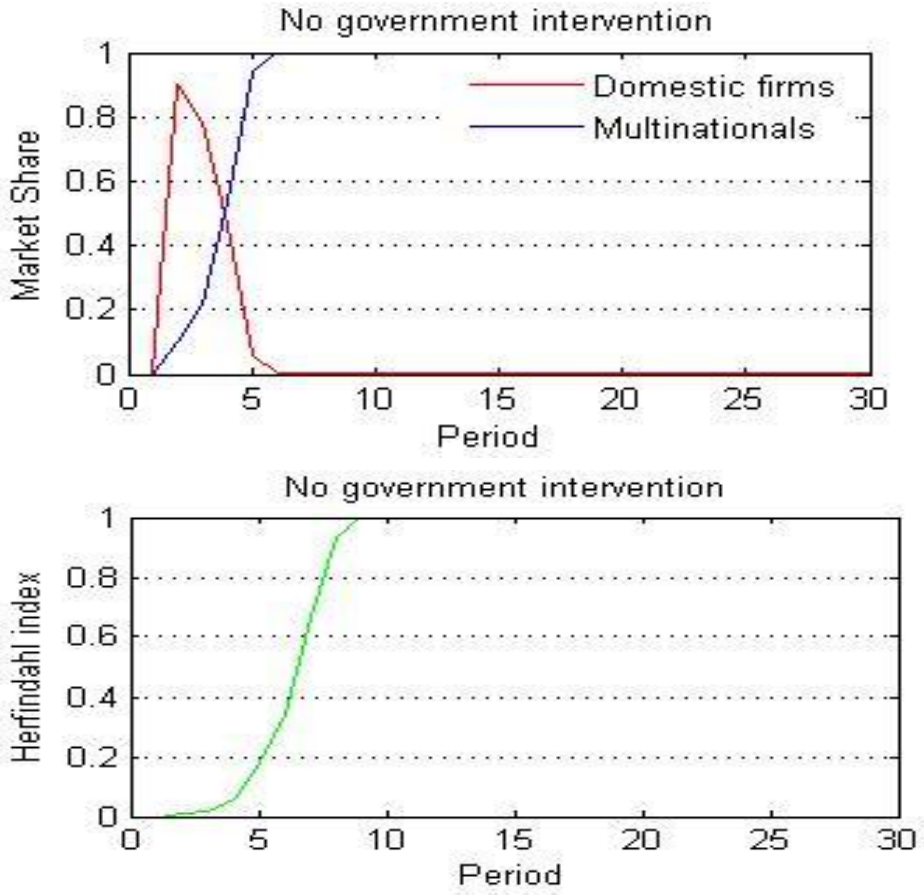


Figure 1

Fig 1 depict the evolutionary process of a mature industry.

After several periods of running, the domestic firms will lost their market and multinationals will take up the whole market (Fig 1).

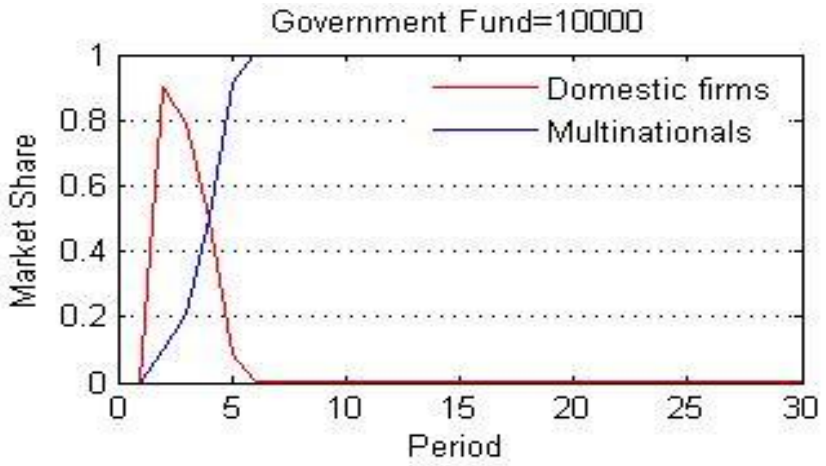
(**stochastic result)**

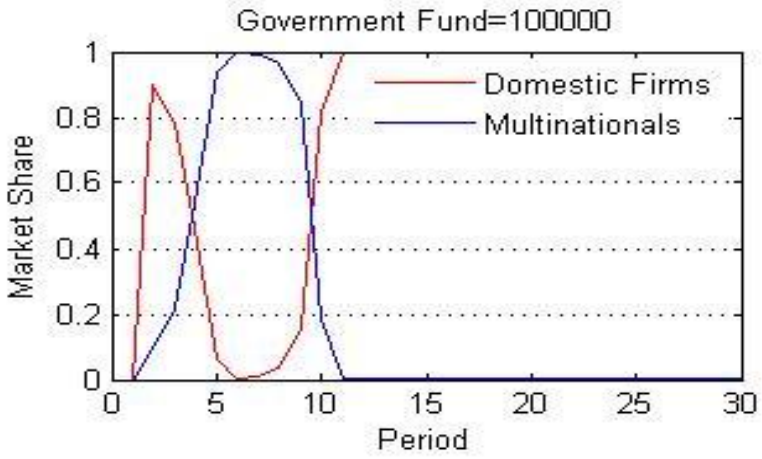
6.2 Government directly fund the R&D of large domestic firms

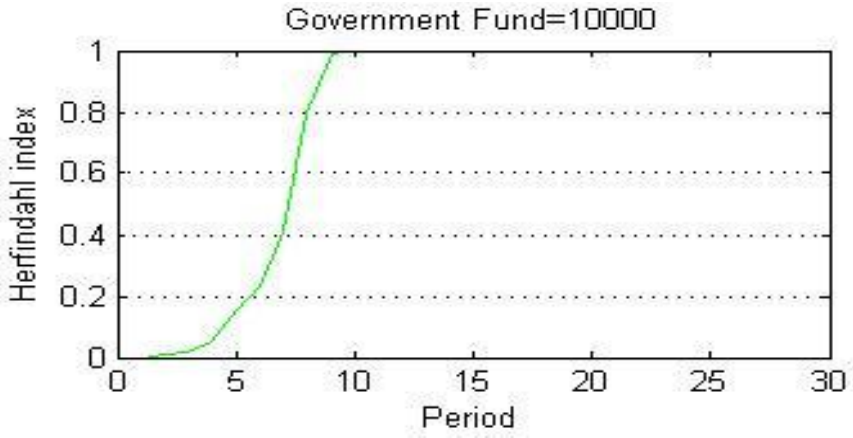
- In this part, we suppose that the government of domestic firms will fund the R&D of the comparatively large domestic firms when they find that the market share of domestic firms decline rapidly under the parameter condition of Fig 1.

- the government will fund the top three domestic firms which have the highest market share at the end of period 5. The government will continuously sponsor those firms for 10 periods. After period 15, the government will stop funding them.

Government directly fund the R&D of large domestic firms







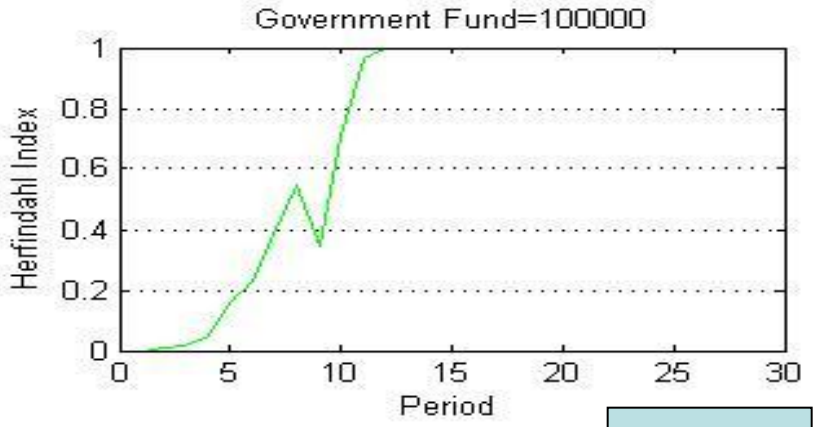


Figure 2

The domestic firms might get competitive advantage by the government's research and development investment when the amount of funds is big enough (Fig 2). The market structure will not change when the government fund is equal to 10000 while the domestic firm can defeat the multinationals when the government fund is equal to 100000 (Fig2). (**stochastic result**)

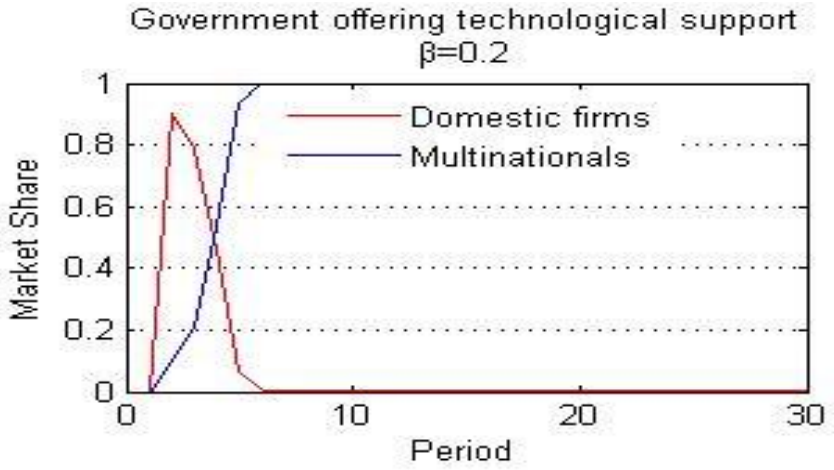
6.3 Government offer technological support to the small domestic firms.

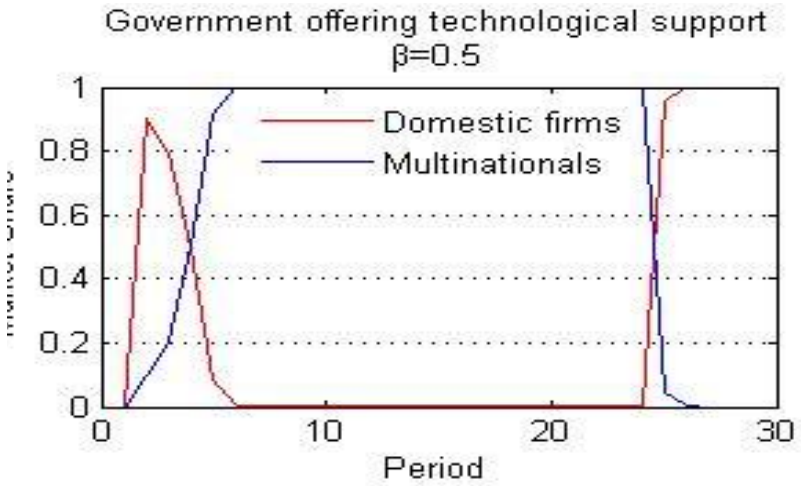
- In this part, we suppose that the government will offer technological support to the small domestic firms through research institutions. All the domestic firms in the market can get technology randomly from the government supported research institutions.

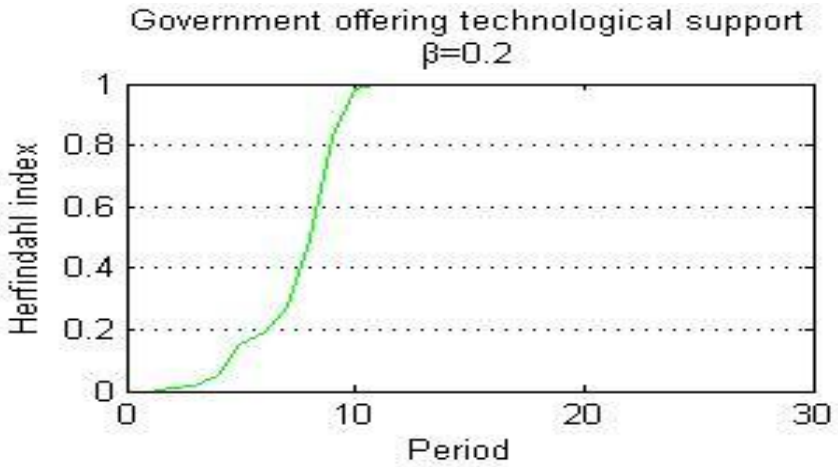
- the probability of acquiring technology of each firm in each period subjects to the normal distribution(（$N（\lambda_{(t)}, \sigma^2）$, where$\lambda_{(t)}=\alpha+\beta*i$）

- The government will start to offer the technological support from the period 5 and the initial parameters are the same as those used in Figure 1.

Government offer technological support to the small domestic firms







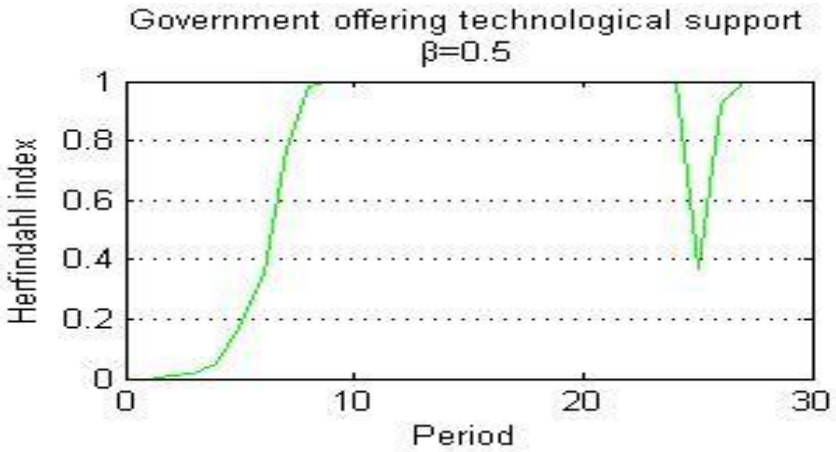


Figure 3

- Some domestic firms may catch up the multinationals if the research institutions which have strong research capabilities can offer new technology to them for free (Fig3).
  (**stochastic result)**

7. Conclusions

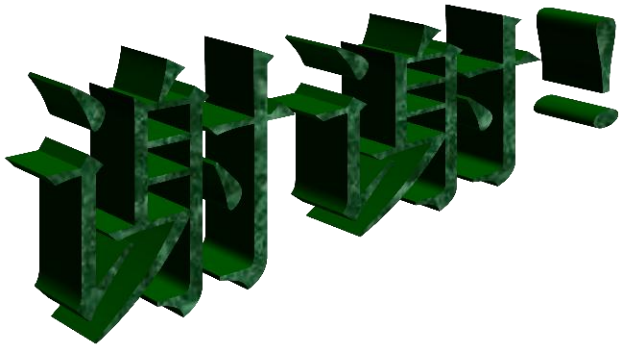
- For the later comer countries, the most important factor is the capability of technological innovation. Whether the market structure is dispersed or concentrated, the later comer countries should try to acquire the capability of continuous innovation first of all.

- The industry competitive advantage could be acquired through different paths.

Conclusions

- The domestic firms can get competitive advantages through the government's R&D investment when the amount of the funds is big enough. the installing of large firms does not mean having competitiveness. Only the big firms which have high innovative capacities can compete with multinationals. If the late comers try to rapid establish large firms by foreign technology but neglect the capability of innovation and learning, the results may be counterproductive.

- it is hard for the small domestic firms in mature industries of later comers to acquire competitive advantages. But it is feasible for later-comer' governments offer technology support to the small firms to acquire competitive advantage under appropriate conditions.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